

cause an increase in other run-off-road crashes (the vehicle hits another object). This countermeasure also reduces the average percent of injury and fatal crashes.

A study (Creasy and Agent, 1985) based on a combination of 42 literature reviews, 22 state surveys, and a before-after analysis, provided the subjective estimate that a 50-percent reduction should occur in fatal crashes due to the removal of fixed objects. Similarly, a 15-percent reduction should occur in injury only crashes after removal of fixed objects.

A comprehensive study for the FHWA (Smith et. al., 1983) estimated percent reduction for several countermeasures. This study was based on improvements at hazardous conditions. The authors emphasize the percent crash reduction estimated are not directly applicable to moderately or mildly hazardous locations. Locations where fixed objects were either removed or relocated resulted in the following estimated values.

Table A-47. FHWA Fixed Object Removal Crash Reduction Estimates

Alignment Changes	Mean Percent Crash Reduction			
	Total	Fatal	Injury	Property Damage Only
Remove / Relocate Fixed Objects	60	65	60	55

One accident reduction factor study (SDDOT, 1998) evaluated sixty-two hazardous sites and attempted to quantify accident reduction factors (ARFs) for the sites. These ARFs were calculated by dividing the total number of crashes following an improvement project by the total number from previous years. A value greater than one, therefore, represents an increase in the number of crashes. Removal of a fixed object resulted in an ARF of zero (or a 100-percent crash reduction). It is important to note that of the sixty-two improvement sites, only one site involved removal of fixed objects so this ARF is from a single data point.

A 1970's study in Georgia (Wright & Mak, 1972) determined that the presence of fixed objects along the roadside has little effect on off-road accident experience. Off-road accident rates are not closely related to the presence of continuous roadside objects. Basically, this means that a person is no more likely to run off the road and crash at locations with roadside objects as at locations without objects.

e. Convert Object to Breakaway

The literature dealing with converting a roadside object to a breakaway type is very sparse. But the few studies that have dealt with this countermeasure have provided positive feedback on its effects on the severity of crashes.

Based on the combined estimates resulting from a survey of 43 states and the District of Columbia and a comprehensive literature review, Kentucky researchers